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ART. XIX.—*The Palaeozoic Starfish of Victoria.*

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(With Plates X–XII.)

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The Palaeozoic Stelleroidea of Victoria constitute, with three exceptions, the whole of that group known from the Palaeozoic rocks of Australia. This paper deals only with the Asteroidea. The Asteroidea were first recognized in Victoria by McCoy, who in 1874 described two forms, *Urasterella selwyni* and *Petraster smythi*, from Silurian strata. The list of species recorded or described prior to the publication of the present paper is as follows. They are arranged according to date of publication:—

Species.	Reference.
<i>Petraster smythi</i> McCoy McCoy, 1874
<i>Urasterella selwyni</i> McCoy Ibid.
<i>Palaeaster meridionalis</i> Eth. fil.	.. Etheridge, 1891
<i>Urasterella</i> sp. (two species)	.. Chapman, 1913

In the present work the authors have re-examined the above forms, as well as a considerable amount of new material. As a result the faunal list now comprises fifteen recognizable species, of which ten are new. These are distributed over eight genera, of which five have not hitherto been recorded from Victoria. All the starfishes recorded are from the Silurian. The list now known from Victoria is as follows:—

Species.	Horizon.	Locality.
<i>Caractacaster yarraensis</i> , sp. nov.	Silurian (Yarravian)	South Yarra
<i>Hudsonaster australis</i> , sp. nov.	Silurian	Yan Yean
<i>Palasterina flemingtonensis</i> , sp. nov.	Silurian (Yarravian)	Moonee Ponds
<i>P. stachi</i> , sp. nov.	Silurian (Yarravian)	Melbourne (excavations)
<i>P. umbonata</i> , sp. nov.	Silurian	Plenty Ranges
<i>P. sp.</i>	Silurian (Yarravian)	South Yarra
<i>Petraster</i> (?) aff. <i>americanus</i> (d'Orbigny)	Silurian	Kinglake West
<i>P. angustior</i> , sp. nov.	Silurian (Yarravian)	South Yarra

Species.	Horizon.	Locality.
<i>P. richi</i> , sp. nov.	Silurian	Clonbinane
<i>P. smythi</i> McCoy	{ Silurian (including Yarravian)	Kilmore, Moonee Ponds
<i>Promopalaeaster meridionalis</i> (Eth. fil.)	Silurian (Yarravian)	Moonee Ponds
<i>P. meridionalis</i> (Eth. fil.) var. <i>parvior</i> , nov.	Silurian (Yarravian)	Moonee Ponds
<i>Urasterella cresswelli</i> , sp. nov.	Silurian (Yeringian)	Lilydale
<i>Salteraster selwyni</i> (McCoy)	Silurian	Kilmore
<i>S. biradialis</i> , sp. nov.	Silurian	Kilmore
<i>Schuchertia junori</i> , sp. nov.	Silurian	Kinglake West
<i>S. macrarta</i> , sp. nov.	Silurian (Yarravian)	Brunswick

Outside Victoria the only known Australian asteroids are (?) *Australaster stutchburii* (Eth. fil.) and *Monaster clarkei* (de Koninck), which are both from the Permo-Carboniferous of New South Wales and have not been studied by the authors.

With few exceptions, the material studied has been preserved in sandstone. A few have been preserved in mudstone, but the result is generally not so satisfactory. In the course of preservation the calcite ossicles have been dissolved away while the intervening spaces have been filled with matrix. The specimens, therefore, have a negative character, and a wax squeeze is necessary for examination. Most of the material was in the National Museum, Melbourne, and the Museum of the Geology School, University of Melbourne. The latter portion was generously placed at our disposal by Mr. F. A. Singleton, M.Sc. Some of the best Kinglake specimens were recently presented to the Museum by Mr. P. Junor, while others were collected by the senior author. The bed at Yan Yean from which *Hudsonaster australis* was obtained was discovered by both authors.

The genera *Hudsonaster*, *Caractacaster*, *Promopalaeaster*, and *Petraster* are restricted to the Ordovician in England and America. *Urasterella*, *Salteraster*, and *Schuchertia* begin in the Ordovician, but range into the Silurian. *Palasterina* is the only Victorian genus which does not occur elsewhere lower than the Silurian. This would seem to indicate that asterid distribution started from a point in the Northern Hemisphere.

The classification adopted in this work is that due to Schuchert (Schuchert, 1915) with the addition of the following genera by Spencer (Spencer, 1914, *et seq.*) viz., *Caractacaster* and *Salteraster*. To these comprehensive works on the American and British stellerioidea respectively, the authors are very deeply indebted.

Class STELLEROIDEA.

Sub-Class ASTEROIDEA.

PHANEROZONIA Sladen.

Family HUDSONASTERIDAE Schuchert.

Genus **Hudsonaster** Stürtz.

HUDSONASTER AUSTRALIS, sp. nov.

(Pl. X., Fig. 6; Text-figs. 1, 3.)

Description.—Small disc, with five short, tapering, rays; interbrachial arcs absent, each interbrachial area occupied by a prominent bullate axillary plate.

Apically, usually three columns of large tumid and tuberculate plates are well shown (one radial, two supramarginals) and portions of two inframarginals, making five in all. The disc consists of a small, tumid, central disc-plate surrounded by still smaller accessory plates of variable size and extending to the arms. Madreporite not detected with certainty, though in the paratype one of the prominent axillary plates appears to be striate.

Orally, the narrow ambulacral channels may be entirely roofed over by the adambulacrals, or they may be open exposing markedly carinate rectangular ambulacrals. In the holotype, ambulacrals with prominent, straight carinae are closely packed, the podial pores being small and located in the suture between the ambulacral groove and the adambulacrals. In the paratype the ambulacrals, with their sharp T-shaped carinae, and similarly placed large, distinct, podial pores, are less closely packed.

Ambulacrals opposite, about 15 in number. Adambulacrals small, rounded, one to each ambulacral plate. Inframarginal plates large, elongate, rectangular, strongly tuberculate, rapidly diminishing in size distally. Oral armature consists of elongate basal adambulacral plates.

Dimensions.—Syntypes, $R = 8$ mm., $r = 2.5$ mm., width of arms at base $= 2.5$ mm. Other specimens have similar dimensions.

Remarks.—The syntypes were obtained by splitting a slab of sandstone, a mould of the apical side coming away with one half and a mould of the oral side with the other. A portion of the mould of the central plate system of the apical side came away with the mould of the oral side, thus obscuring the mouth structure. In the paratype, however, this portion is clearly seen. Both agree in every essential feature with the generic characters of *Hudsonaster*, in size, arrangement, and form of plates on the rays both apically and orally, and in the primitive structure of the interbrachial areas.

Schuchert (1915, pp. 31-36) regards *Hudsonaster* as the most primitive Ordovician Stelleroid, and states that it is "near the radicle that gave rise through modification and inheritance to all the subsequent Stelleroidea." Spencer (1915, p. 57) combats this view, and claims (*ibid.*, 1914, p. 5) that the Stelleroidea were evolved from primitive stalked forms with a simple arrangement of plates.

Of the American forms, our species most resemble *H. narrawayi* (Hudson) (Schuchert, 1915, p. 59, fig. 1; pl. ii., fig. 1, pl. iv., fig. 1) from the Middle Ordovician (Black River), U.S.A. *H. australis* is comparable in size, but has several more ambulacral plates to each arm. Furthermore, *H. narrawayi* has not the characteristic T-shaped carinae on the ambulacrals of the Victorian specimen.

Another somewhat related form is *H. matutinus* (Hall), (Schuchert, 1915, p. 57, pl. 2, fig. 2; pl. 3, fig. 2; pl. 5, figs. 1, 2) from the Trenton Limestone (M. Ordovician) of U.S.A., but that species has wider ambulacral grooves and less round interbranchial marginals. The disc is somewhat narrower, and the disc plates larger. *H. milleri* Schuchert (*ibid.*, p. 60, pl. 4, fig. 2) from the Trenton Limestone is very similar, but apart from its oral side it is little understood.

Associates.—*Ampyx yarraensis* Chapman, *Lindstroemia parva* Chapman, Brachiopods indet., Crinoids indet., &c.

Horizon.—*Hudsonaster* has hitherto been recorded from the Middle and the Upper Ordovician of America and the Upper Ordovician of the Girvan District, Scotland. Its occurrence in Victoria is undoubtedly Silurian, but the beds from which it was obtained have not so far been correlated with any other bed either stratigraphically or palaeontologically. Its associated forms are known from the Melbourne area, but their ranges have not been ascertained.

Locality.—At the summit of an anticline in a cutting on Yan Yean-Arthur's Creek-road, $\frac{1}{3}$ mile east of Doreen Junction.

Family PROMOPALAEASTERIDAE Schuchert.

Sub-Family MESOPALAEASTERINAE Schuchert.

Genus **Caractacaster** Spencer.

CARACTACASTER YARRAENSIS, sp. nov.

(Pl. X., Figs. 1, 2; Text-figs. 2, 4.)

Palaeaster meridionalis Eth. fil., Chapman, 1913, *Aust. Ass. Adv. Sci.* xiv., p. 214.

Comparing those forms relegated to *P. meridionalis* with Etheridge's type, which was kindly loaned to us by the Australian Museum, Sydney, we are convinced that they are generically distinct and conform to the characters of *Caractacaster*, a

genus erected by Spencer (1916, p. 80) on *Palaeaster caractaci* Gregory, of the Upper Ordovician (Caradocian) of the Welsh border.

Description.—From a relatively small central disc, five rays with straight borders taper rapidly, forming an obtuse interbrachial angle. Apically, the disc consists of a depressed central portion with a rather small centrale, surrounded by three circles of intermediate plates set in irregularly preserved smaller accessory plates.

Rays with a central row of round, tumid and tuberculate radialia, of which the primary plate is only very slightly larger than the remainder. To each side of these is a single row of small and in the distal portions indistinct row of adradialia. The arms are bordered by a row of prominent rectangular supramarginals, which decrease in size only slowly as the tip of the arm is approached. Interbrachial areas distinguished by a somewhat enlarged transverse primary interr radial and bordered by supra-marginals.

Orally, distinguished by a prominent, rather pear-shaped interbrachial axillary, only slightly enclosed by the adjacent inframarginals. Ambulacral grooves deep, wide, and gradually tapering. Ambulacral plates, 15 or 16 in number, and bearing a prominent L-shaped ridge. Podial pores situated laterally, close to the adambulacrals.

Adambulacrals and inframarginals, both rectangular and about equal in number, border the rays.

Structure of the mouth not well defined, but in the holotype the oral armature appears to be formed by the prolongation of spines from the proximal ambulacral. The spines are curved and elongate, and are separated from the axillary interbrachial by two small adambulacrals.

Dimensions.—Holotype, $R = 8$ mm., $r = 2.5$ mm. Paratype, $R = 10$ mm., $r = 3.0$ mm.

Remarks.—In the holotype, one primary interr radial is replaced by a rounder and more tumid plate, probably the madreporite. In a portion of the rays, the adambulacrals and inframarginals appear to be fused into a series of very transverse plates. Closer inspection suggests, however, that this is only a false fusion due to petrification; in the holotype a few of the proximal plates show separate rectangular adambulacrals and inframarginals.

C. yarraensis is smaller than *C. caractaci* (Gregory) (Spencer, 1916, p. 80) of the Upper Ordovician of the Welsh border, and has fewer ambulacrals, and the oral armature appears somewhat less elongate. *C. intermedius* (Schuchert) [= *Mesopalaeaster intermedius* Schuchert] (Schuchert, 1915, p. 79) is similar in size, and resembles our species in the occurrence of two small adambulacrals between the interbrachial

marginal and the oral armature. The interbranchial marginal and inframarginal plates are, however, more prominent in *C. yarraensis*, and the coarse granulation of the adambulacral plates found in the American species is absent. *C. intermedius* is an Upper Ordovician form in the United States of America.

Other species which it resembles belong to the related genus *Mesopalaeaster*. *M. bellulus* (Billings) occurs in the Silurian (Rochester Shale) of Ontario, and is larger, as well as exhibiting some differences in the inframarginal plates. *M. shafferi* of the Upper Ordovician (Cincinnati Group) is comparable in size, but shows the arms terminating apically in large radial plates. There are also oral differences.

Associates.—*Petraster angustior* sp. nov., brachiopods, pelecypods, trilobites, &c.

Horizon.—Silurian (Yarravian Series).

Locality.—South Yarra, Victoria.

Sub-Family PROMOPALAEASTERINAE Schuchert.

Genus **Promopalaeaster** Schuchert.

PROMOPALAEASTER MERIDIONALIS (Eth. fil.).

(Pl. XII., Fig. 7; Text-fig. 5.)

1891. *Palaeaster meridionalis* Eth. fil., *Rec. Aust. Mus.*, i., pp. 199-200, pl. xxx., figs. 16, 17.

Original description (emended).—Body small; rays moderately long and rather acutely pointed, 15 mm. from the actinial centre to the apices; interbranchial angles broad and obtuse; abactinial surface unknown. Ambulacral avenues wide in comparison to the size of the body, deep, very gradually tapering [except at distal end where they taper quickly], the sides more or less straight-walled; ambulacral plates about 20 in number on each side, transversely oblong, bearing more or less pyriform pores [placed close to the adambulacral plates]; adambulacral plates quadrangular [tumid and granulose], [proximally much] smaller than the marginal plates, placed along the prominent edges of the ambulacral avenues; marginal plates transversely elongated, [tumid and pustulose], slightly supra-marginal in position, and thus partially visible dorsally, diminishing very gradually in size towards the apices of the rays; interbranchial marginals [inframarginals] apparently two in number [it is quite clear there are two], much larger than the others, and generally triangular in shape [orad to these are two small interbranchial marginals]. Oral plates not distinctly visible but apparently lanceolate. [They can be quite well seen, are lanceolate in shape, and adambulacral in origin.]

Dimensions.—R = 16 mm.; r = 6 mm.

Observations.—Definitely a *Promopalaeaster*. Many species of *Mesopalaeaster* bear a quite striking superficial resemblance, particularly *M. shafferi* (Hall) (= *Palaeaster shoefferi* Hall), from Upper Ordovician (Cincinnati) U.S.A.; but *Mesopalaeaster* has a single pentagonal axillary interbrachial, while *Promopalaeaster* commonly has two or more interbrachial marginals in addition. *Promopalaeaster meridionalis* has two of the latter; but the former cannot clearly be seen.

Etheridge (Etheridge, 1891) compared his species with several *Promopalaeasters*, namely *P. granulosus* (Hall), *P. antiquatus* (Locke), *P. exculptus* (Miller), and *P. dyeri* (Meek), all of which were then called *Palaeaster*, and, as Etheridge pointed out, were much larger than the Australian species, and exhibited other differences.

A species comparable both in size and in other ways is *Promopalaeaster wykoffi* (Miller and Gurley) (Schuchert, pp. 119-120, pl. 18, fig. 6, pl. 19, fig. 2), from the Upper Ordovician (Richmondian) of U.S.A.; but the rays are not as pointed, and the ambulacral furrow is wider.

Associates.—*Petraster smythi* McCoy; *Gregoriura spryi* Chapman; also brachiopods, pelecypods, trilobites, &c.

Horizon.—Silurian (Yarravian Series).

Locality.—Moonee Ponds, Victoria.

PROMOPALAEASTER MERIDIONALIS (Eth. fil.) var. PARVIOR, nov.
(Pl. X., Fig. 5.)

The specimen shows the oral surface of one complete arm, and the margins of the two adjacent arms.

Description.—Arm petaloid, with wide and shallow ambulacral groove. Ambulacrals with a sharp T-shaped carina which unites with a narrow extension from the adjacent adambulacral. Adambulacrals prominent, subquadrate distally, but becoming transverse proximally; largest near centre of ray; surface convex and pustulose; 17 in length of arm. Podial openings large, situated in sutures between ambulacrals and adjacent to adambulacrals. Inframarginal plates smaller than adambulacrals, rectangular proximally, but rapidly decreasing in size, and becoming elongate distally. Interbrachial angles acute, bounded by inframarginals. Between inframarginals and the pair of proximal adambulacrals which form the mouth angle-plates is a small area probably occupied by accessory plates. The structure has not been preserved sufficiently well for description.

Dimensions of Holotype.— $R = 7.5$ mm.; $r = 4$ mm. Width of arm at widest part, 3.5 mm.

Remarks.—The variety, as the name indicates, is smaller than *P. meridionalis*. The arms also taper more rapidly in the distal half, giving a more petaloid appearance. The inframarginals

are not as large nor as quadrate, nor are there as many plates developed in the interbrachial areas. Possibly all these characters may be due to greater youth.

Associates.—*Promopalaeaster meridionalis* (Etheridge), *Petraster smythi*, &c.

Horizon.—Silurian (Yarravian Series).

Locality.—Moonee Ponds Creek, Flemington. Collected by Geological Survey of Victoria.

Family PALASTERINIDAE Gregory (emend.).

Genus **Petraster** Billings.

PETRASTER (?) aff. AMERICANUS (d'Orbigny).

1915. *Petraster* (?) *americanus* (d'Orbigny), Schuchert, p. 146, pl. 26, fig. 2.

The specimen occurs on the same slab as *Schuchertia junori*, sp. nov. (*q.v.*), and is only partially exposed. The large inframarginals bounding both the arms and the interbrachial arcs suggest it is a *Petraster*, while the shape and arrangement of the other ossicles most closely resemble the above form.

Horizon.—Silurian.

Locality.—Collins Quarry, Kinglake West, Victoria.

PETRASTER ANGUSTIOR, sp. nov.

(Pl. XII., Figs. 4, 5; Text-fig. 6.)

1913. *Palaeaster smythi* (McCoy), (*pars.*) Chapman, *Aust. Assoc. Adv. Science*, p. 214.

Specimens 372-6 of the National Museum Collection, Melbourne, were labelled *Palaeaster smythi* (McCoy) in 1902, and published as such above. Specimens 372-4 are in a hard brown sandstone and specimens 375 and 376 in a soft grey mudstone. All five specimens prove to be quite distinct from *Petraster smythi* McCoy. The first three are described as *Petraster angustior*, sp. nov., but the last two can be described only as *Palasterina* sp.

Description.—Arms five, sharply pointed and tapering rapidly from broad central disc. Each arm has a prominent central ridge along which are situated the convex, polygonal, and pustulose radials. To either side, but on the slopes of the ridge, is a row of small irregular accessory plates, increasing to two rows within the confines of the disc. At the base of the ridge is a row of supramarginals, similar in appearance to the radials, but smaller. The arms are bordered by relatively large subquadrate inframarginals, between which and the supramarginals there is, proximally, a row of ambital plates. Disc large, and characterized by a stellate pentagonal ridge. This is made by the union of the adjacent portions of the ridge from each ray, which portions bifurcate proximally. Inside of this pentagon

is a small rounded central disc plate surrounded by a ring of rather smaller plates, the whole interspersed with small accessory plates. Interbrachial areas broad and obtuse, bordered by inframarginals, and consisting of a number of small polygonal plates. Ambulacral plates (visible from apical side of specimen 372) transversely rectangular.

Dimensions of Holotype.— $R = 16$ mm.; $r = 6$ mm. Width of arm at base, 5 mm.

Remarks.—*Petraster angustior*, as the name indicates, has less stout arms than *Petraster smythi*. Further, the inframarginals are not so large, especially in the interbrachial arcs. The nearest foreign species is *P. speciosus* (Miller and Dyer), which is also the form nearest to *P. smythi*. *P. speciosus* has the distinctive central ridge on the arms like the Victorian species; but it is larger.

Associates.—*Caractacaster yarraensis*, sp. nov.; brachiopods, pelecypods, trilobites, &c.

Horizon.—Silurian (Yarravian Series).

Locality.—South Yarra.

PETRASTER RICHI, sp. nov.

After this paper had gone to press, some recently-acquired specimens were brought under our notice by the Director of the Geological Survey of Victoria. They have moderately stout petaloid arms. Prominent inframarginals border the arms and continue across the obtuse interbrachial angles. Between them and the mouth angle-plates is a series of small accessory plates. These features indicate the genus *Petraster*. The form is less stout than *Petraster smythi* McCoy; and has more petaloid arms and larger inframarginal plates than *Petraster angustior*, sp. nov.

Horizon.—Silurian.

Locality.—1 mile south-east of the Clonbinane Pre-emptive Right, just above junction of Comet and Sunday Creeks. Specimens 34,508–34,510, 34,514, Geol. Surv. Mus. Pres. by T. Rich, Esq.

PETRASTER SMYTHI McCoy.

(Pl. XII., Figs. 1, 2.)

1874. *Petraster smythi* McCoy. McCoy, *Prod. Pal. Vic.*, Dec. 1, p. 41, pl. x., figs. 1, 1a, 1b.

1913. *Palaeaster smythi* (McCoy) (*pars.*) Chapman, F. On the Pal. of the Sil. of Vict., *Aust. Assoc. Adv. Science* 1913, p. 214.

The genus *Petraster* was founded by Billings in 1858; but the genotype was considered by James Hall in 1868 to be a *Palaeaster*. Hence the listing of *Petraster smythi* McCoy as *Palaeaster smythi* (McCoy) by Chapman in 1913.

Schuchert, however, in his 1915 monograph (p. 142) was able to show that Billing's holotype was "a normal individual of a distinct genus," and not a *Palaeaster* as considered by Hall. In the circumstances McCoy's original name for the Australian species must stand. McCoy's specimen was not a clear one, but Schuchert (1915, p. 148) regarded it as a genuine *Petraster* "so far as could be judged from the description and illustrations." We are able to confirm Schuchert's conclusion; and from specimens obtained by the late Mr. George Sweet from the Silurian of E. Kilmore, have been able to select an excellent plesiotype. Specimens from the Silurian of South Yarra, listed by Chapman in 1914 as "*Palaeaster smythi*" can be shown on examination to be a distinct species of *Petraster* with narrower arms than *P. smythi*. This is described above as *Petraster angustior*. The plesiotype shows very clearly the prominent inframarginals bordering the entire form, and the stout ridged arms, typical of *Petraster*.

Description of Holotype.—Five broad semi-elliptical lobes meeting at slightly rounded re-entering angles, leaving the length and the width at the base of the rays nearly equal, and less than the width of the disc. The upper surface is covered with irregularly polygonal tumid plates. Madreporiform tubercle very large ($1\frac{1}{3}$ lines = 2.5 mm. in diameter). irregularly porous, and rugged with branching vermicular ridges, excentric towards base of the two posterior ridges. Ambulacral groove narrow, bordered with a row of large transversely oblong adambulacral plates, wider than long, about 6 in 2 lines (7 in $\frac{1}{2}$ cm.) at middle of ray. [This interpretation is surely wrong. The transverse plates are the flooring plates of the ambulacral groove. They are opposite, and about 12 in a column.] Margin of rays bordered with a rather smaller row of similar (?) marginal plates (inframarginals). [These are smaller and not so transverse.] Between the row of adambulacral [ambulacral] and (infra) marginal plates an intercalary row of small irregular plates. [No evidence can be found of such "irregular" plates; the "intercalary" rows referred to are the adambulacrals, which are smaller and less transverse than the ambulacrals.]

Width of disc between the rays 7 lines; from tip to tip of rays, about 1 inch 2 lines, length of ray about 5 lines.

Dimensions.— $R = 1.5$ cm., $r = 7$ mm.

Remarks on Holotype.—The holotype is an impression of the dorsal side; but in the case of two of the rays, the apical plates are missing, and the ambulacral plates are seen from the inner side. The specimen must have suffered a good deal of crushing in the course of preservation, for many of the plates are displaced from their normal position, and the structure is not easily distinguished. McCoy's figure is not an accurate reproduction of the specimen but a generalized drawing showing the structure.

Horizon.—Silurian (Yarravian Series).

Locality.—Flenington, near Melbourne.

Description of Plesiotype.—Apical side only. Five short, stout arms emerging from a broad central disc. The entire body of the animal is bordered by prominent granulate inframarginals. These are small and rectangular distally, but become much larger and elongate in the interbrachial arcs, where they are 4-5 times as long as broad, the long axis being transverse to the margin. The total number from the tip of one ray to that of an adjacent ray is about 20. A striking feature is their loose arrangement. Rays with a central row of polygonal radials, situated on a ridge, with a row of supramarginals on each side, followed by the inframarginals. Proximally the axis of the rays is occupied by two column of plates, which with the two supramarginal and two inframarginal columns makes six in all, as McCoy shows in his figure of the holotype. Proximally numerous accessory plates developed between the radial and supramarginal columns and particularly between the latter and the bounding inframarginals. The supramarginals can be traced in a broad arc across the interbrachial areas, between which and the boundary of the disc is a copious development of small accessory plates. Structure of central part of disc, and position of madreporite uncertain.

Dimensions.—R 16 mm., r = 6 mm.

Remarks.—The nearest related species is *Petraster speciosus* (Miller and Dyer) (Schuchert, 1915, p. 142, pl. 23, figs. 5-7; pl. 26, fig. 1; pl. 27, figs. 1-4) from the Upper Ordovician of the United States of America. The latter has, however, inframarginal plates which do not increase so much in size in the interbrachial areas, while the interbrachial arcs are more obtuse. While some of the specimens of *P. speciosus* are of similar size to our species, others are twice the size.

Associates.—*Salteraster selwyni* (McCoy); *Salteraster biradialis*, sp. nov.

Horizon.—Silurian.

Locality.—East Kilmore. Discovered by the late Mr. G. Sweet, in yellow micaceous sandstone, and comprising part of the Sweet Collection presented by him to the National Museum.

Genus **Palasterina** McCoy.

PALASTERINA sp.

1913. *Palaeaster smythi* (McCoy) (*pars.*) Chapman, *Aust. Assoc. Adv. Science*, p. 214.

The two specimens (375, 376) now described as *Palasterina* sp. were labelled in the National Museum, Melbourne, as *Palaeaster smythi* (McCoy) (now known as *Petraster smythi* McCoy).

They were with three others (372-4) from the same locality which in this paper have been designated *Petraster angustior* sp. nov. From the latter specimens, numbers 375 and 376 differ completely. The arms (the oral side only of which is preserved) are bordered by adambulacral plates only, and the interbrachial angles are acute. The grooves are wide and shallow, and the rectangular ambulacrals bear L-shaped carinae. The arms taper gradually as far as they are preserved, but the distal half of three of them is missing. In the remaining two the distal portion of two adjacent arms has been bent back into an interbrachial angle. This gives a false appearance of a broad disc, which perhaps accounts for their original identification. *Petraster* is further excluded by the absence of inframarginals from the arms.

Associates.—*Petraster angustior*, sp. nov., *Caractacaster yarraensis*, sp. nov., &c.

Horizon.—Silurian (Yarravian Series). The specimens are preserved in a grey mudstone. It is worth noting that the three other specimens from the same locality which were classed in the National Museum as *Palacaster smythi* were in a hard brown sandstone.

Locality.—South Yarra. Collected by the late Mr. F. P. Spry.

PALASTERINA FLEMINGTONENSIS, sp. nov.

(Pl. XI, Fig. 3; Text-fig. 7.)

1913. *Urasterella* sp., Chapman, *Aust. Assoc. Adv. Science*, p. 214.

This species is based on four specimens from the Silurian of "Flemington," and judging from the distinctive matrix, probably from the Geological Survey Locality (B8). Two were labelled *Tacniaster* by McCoy, and later *Urasterella flemingtonensis*, sp. nov., by Chapman. Another (the holotype of the present species) was labelled "*Urasterella*, sp. nov., but not *Urasterella flemingtonensis*," and the fourth, "*Urasterella* (?) sp." In spite of a certain variation in size, all four specimens have the same specific structure. Unfortunately the oral side only is preserved.

Description.—Five long slender arms tapering slowly and uniformly to a sharp extremity. Ambulacral grooves wide and deep, the floor made of about fifteen stout rectangular ambulacrals with a strong and rather broad T-shaped ridge. The lateral end of this ridge is in line with a projection from the adjacent adambulacral. The adambulacral plates are prominent, rectangular to quadrate, and without exception have a convex tuberculate surface. Spines formerly attached can be seen alongside parts of the arms. Inframarginal plates elongate rectangular, but visible only for a short distance from interradius. Interbrachial structure consists of a stout lunate interbrachial axillary plate adoral to which are a pair of curved tuberculate mouth angle-plates.

Dimensions of Holotype.— $R = 20$ mm.; $r = 4$ mm. Other specimens range from this size to one-half.

Remarks.—The above form has been identified as *Palasterina* on account of the wide ambulacral grooves bordered by the characteristic convex tuberculate adambulacrals. The mouth angle-plates, too, are of the *Palasterina* type; as are also the poorly developed inframarginals. *P. flemingtonensis* is distinguished from *P. stachi* (q. v.) by the absence of the wide border of ambital plates, and of the stellate interbrachial plate. The narrowing of the ambulacral groove towards the disc is not well marked in *P. flemingtonensis*, though it can be seen in one of the arms. This suggests that this character may not be specific, but may merely indicate the degree to which the animal has opened the groove. In the case of *Palasterina stachi*, however, the constriction is so marked on each arm that it is surely specific. *Palasterina flemingtonensis* is most closely related, among foreign forms, to *Palasterina primæva* (Forbes), (Spencer, 1922, p. 223, pl. xv., figs. 5-7; pl. xvii., fig. 3, text-figs. 30, 138, 157-164) from the Ludlow of Westmoreland, England. The latter is about the same size; and lacks the abundant development of ambital and interrarial plates seen in some species of *Palasterina*, but not in *Palasterina flemingtonensis*. The interbrachial axillary plate has a concave proximal edge and convex distal edge in both forms, but is more slender in the Australian species. In *Palasterina primæva*, the tubercles on the adambulacrals are restricted to a ridge; but in *P. flemingtonensis* they are distributed over the whole surface. This indicates a more primitive stage of development.

Associates.—*Sturtzura brisingoides* (Gregory); *Furcaster leptosomoides* (Chapman); *Petraster smythi* McCoy; also brachiopods, pelecypods, and trilobites.

Horizon.—Silurian (Yarravian Series).

Locality.—“Flemington,” near Melbourne.

PALASTERINA STACHI, sp. nov.

(Pl. XI., Figs. 4, 6.)

Description.—Rays, five, rather stout, uniformly tapering. Ambulacral groove wide, deep and petaloid, broadest about distal end of proximal third, tapering from there to mouth and more so distally. Ambulacrals sub-rectangular, wider than long, and with prominent L-shaped ridge, the foot of the L directed proximally; 10 to 12 in 10 mm. Adambulacral plates sub-quadrate, convex and granulate; number about the same as the ambulacrals. Mouth angle-plates small, swollen and distinctly curved. Interbrachial angles characterized by a large interbrachial marginal plate, which is convex and hexagonally stellate with a rib radiating to each point, and distinctly pustulose. No plates intervene between this plate and the mouth angle-plates.

nor between it and the adjacent adambulacrals, but immediately to the side of it are three or four (the exact number cannot be determined) rectangular inframarginals, which rapidly decrease in size along the arm and then disappear.

The rays are bordered throughout their entire length by a series of small, elongate, ambital plates. The width of the border is greatest in the interbranchial areas, but gradually tapers distally. Apically, the arms consist of a prominent row of rounded convex radials on either side of which are a row of more elongate adradials (also convex) and a row of slightly smaller supramarginals.

Dimensions.—Holotype, $R = 20$ mm.; $r = 7$ mm. Paratype, $R =$ about 27 mm.; $r = 7$ mm.

Remarks.—The species is named after its finder, Mr. L. Stach, who a few years ago made a valuable collection of starfishes and crinoids from the Silurian of the Melbourne district.

The holotype shows the oral side; the paratype is a less perfect specimen of the apical side. The form is identified as *Palasterina* by the almost entire absence of inframarginal plates from the oral side, the petaloid arms, the swollen and curved mouth angle-plates and the well-developed ambital plates. The two latter characters exclude *Urasterella*. The polygonal interbranchial marginal, with the few adjacent inframarginals also suggest *Eoactis simplex* Spencer (Spencer, 1920, p. 206, pl. i., fig. 4; pl. xv., fig. 8, text-fig. 147-148); but the latter has well-developed adambulacrals, and no ambital plates. It is also much smaller. The nearest species is *P. antiqua* (Hisinger) from the Wenlock and Ludlow beds of Great Britain (Spencer, 1922, p. 228, pl. iv., fig. 6; pl. xv., fig. 9, pl. xvi., figs. 1, 2, text-figs. 165-170). The ambulacral groove is constricted proximally as in the Victorian species, and in some cases (text-fig. 170) a well-developed interbranchial marginal plate is present. *P. follmani* Sturtz (Spencer, *supra cit.*, pl. xvi., figs. 3-7, text-fig. 171) from the Lower Devonian of Germany is a very much larger species, but has a well-developed axillary plate like *P. stachi*.

Associates.—Crinoids and starfishes indet.

Horizon.—Silurian (Yarravian Series).

Locality.—Excavations for foundations of *Herald* office, corner of Collins-place and Flinders-street, Melbourne.

Holotype and paratype presented to the National Museum by Mr. L. Stach.

PALASTERINA UMBONATA, sp. nov.

(Pl. X., Fig. 4.)

Description.—Five, rather stout, petaloid arms, with wide and shallow ambulacral grooves. Ambulacrals opposite; about 20 in number; rectangular, with prominent proximally directed L-shaped carina. Proximal to carina, and about one-third of

the distance from the central groove to the adambulacral, is a boss-like projection. Adambulacrals equal in number to ambulacrals, small, quadrate, with convex pustulose surface. A slight prolongation of each adambulacral is in line with the carina of the corresponding ambulacral. Oral armature made of five pairs of stout curved mouth angle plates. Interbrachial angles filled with a large reniform interbrachial axillary plate, and a number of other irregular interrachial plates, the largest of which bound the interbrachial arc. Apical side unknown.

Dimensions.— $R = 20$ mm., $r = 5$ mm.

Remarks.—The specimen on which the above is based was labelled *Urasterella* in the National Museum collections. *P. umbonata* is distinguished from *P. stachi* and *P. flemingtonensis* by its broader arms, and the presence of the boss-like protuberances on the ambulacrals. The specific name is a reference to the latter character. *P. stachi* is also distinguished by the greater development of ambital plates.

P. umbonata shows considerable resemblance to *P. primaeva* (Forbes) from the Ludlow of Westmoreland, England. (Spencer, 1922, p. 223, pl. xv., figs. 5-7; pl. xvii., fig. 3; text-figs. 30, 138, 157-164). The size and interbrachial structure are similar; but *P. primaeva* has more prominent adambulacrals, and lacks the boss on the ambulacral plates; it also has less petaloid arms.

Horizon.—Silurian.

Locality.—Near Plenty Ranges, 6 feet beneath surface. Specimen purchased by National Museum from Miss M. E. Macfarlane, 27th February, 1915.

Group CRYPTOZONIA Sladen.

Family URASTERELLIDAE Schuchert.

Genus **Urasterella** McCoy (Emend.).

URASTERELLA CRESWELLI, sp. nov.

(Pl. XII., Fig. 6.)

1913. *Urasterella* sp., *Aust. Assoc. Adv. Science*, p. 223.

Description.—Five slender arms radiating from a small central disc. Each arm has its margins almost parallel or only slightly tapering for three-quarters of its length, after which it tapers more rapidly. Grooves narrow and deep or arched over by adambulacrals. Structure of the ambulacrals not visible. Adambulacrals like coins set on edge, inclined towards the mouth, about nineteen in length of the arm. Viewed orally the adambulacrals appear transversely rectangular with convex surfaces. Outside the adambulacrals is a row of subquadrate inframarginals which extend the whole length of the arm. These increase in size proximally, become less closely packed, and more

triangular in shape. The latter is due to a lateral, probably paxillar, prolongation. Interbrachial angles acute, but structure not discernible. Oral structure also lost. Apical side unknown.

Dimensions.— $R = 10$ mm., $r = 1$ mm. Width of arm at base = 2 mm.

Remarks.—The specimen gives just sufficient information to class it as a *Urasterellid*; but it may be *Salteraster*. In the absence of knowledge of the apical side, it is however best identified as *Urasterella*. Its arms are less petaloid than *Salteraster selwyni*, which form it resembles in size.

Urasterella ruthveni (Forbes) (Spencer, 1918, p. 140, pl. ix., fig. 5; pl. x., figs. 4-6; text-figs. 90, 91) has transverse adambulacra like *U. cresswelli*, and has the same shape of arm; but it is a larger form. It occurs in the Upper Ludlow slates of the Lake District, England. *U. ruthveni* var. *leintwardensis* Spencer (Spencer, 1918, p. 142, pl. ix., figs. 3, 4; text-fig. 92), is a slightly smaller form than *U. ruthveni*, but only the apical side is known. It is found in the Lower Ludlow beds of Herefordshire.

Salteraster (?) *coronella* (Salter) (Spencer, 1918, p. 153, pl. xi., fig. 6; text-fig. 99) is the form closest to *U. cresswelli* in size; but it has a broader disc. It is from Lower Silurian (May Hill Sandstone) of England. *U. cresswelli* is the only asteroid known from the type locality for the Yeringian (Middle Silurian) rocks of Victoria. It is named after the Rev. A. W. Cresswell, who was a student of Professor McCoy's, and who contributed so largely to our knowledge of the Yeringian.

Associates.—It is associated with an abundant fauna of corals, brachiopods, pelecypods, trilobites from the neighbouring mudstones; and of corals, gasteropods, and ostracods from adjacent limestones.

Horizon.—Silurian (Yeringian). Equivalent to Wenlock.

Locality.—Lilydale, Victoria. Collected by the late Rev. A. W. Cresswell from the "mudstone quarries."

Genus *Salteraster* Sturtz.

SALTERASTER SELWYNI (McCoy).

(Pl. XI, Figs. 1, 2.)

1874. *Urasterella selwyni* McCoy. *Prodrom. Pal. Vic.*, Dec. 1, p. 42-43, pl. x., figs. 2, 3.

The name *Salteraster* was proposed in 1893 by Sturtz, who named as the genoholotype, *Palacaster asperrima* Salter. Spencer (1918, pp. 149-152) re-examined this species, and confirmed the erection of the genus *Salteraster*, which he diagnosed as "a *Urasterellid* with all its rows of adradialia exactly similar." Commenting on the Australian species *U. selwyni* he said (p.

155): "The figures and description suggest that the species might really belong to *Salteraster*, but good structural details are not given." An examination of McCoy's syntypes (moulds of the oral and apical sides respectively) confirms Spencer's opinion. Moreover, we have been able to make out some additional structural details.

Description.—Rays five, elongate, gradually tapering from a little beyond the base, which is slightly contracted. Angulated on the upper side by a prominent ridge along the middle of each ray, having a row of conical subcircular plates (radials), about eight in two lines (18–20 per cm.), each side sloping on the dorsal aspect from the middle with about three rows of conical tubercular plates (adradials) rather smaller than the middle row. Three of the rows are exactly alike—the adradials; the fourth—the inframarginals—are only partially visible from the apical side and carry elongate spines. The five axil plates (axillary interbranchials) small, ovate, triangular, very tumid. Plates of central disc consist of a central plate with the five primary radials arranged in a circle about it. Adambulacral plates large (tuberculose) extending to the tubercular margin, (according to McCoy, but it is quite clear that inframarginals are present), transversely oblong, about twice as wide as long (about 9 in two lines = about 12 in 5 mm.), the size decreasing distally. Bounding the adambulacrals for the entire length of the arm is a row of rectangular inframarginals, each with a long grooved spine. It is the outer end of these spines which are visible from the apical side. Ambulacral plates small rectangular and sharply ridged with the characteristic L-shaped carina, and large podial pores situated midway between central groove and adambulacrals, and in a deep ambulacral groove. Surface of plates granular. (Madreporite not observed.)

Dimensions of Syntypes.—Length of ray from mouth to tip six lines ($R = 13$ mm., $r = 2$ mm), greatest width near base $1\frac{1}{4}$ lines (2.5 mm.).

Remarks.—McCoy was unable to describe the character of the oral plates from his types, but other specimens from Kilmore are sufficiently clear to show that *S. selwyni* had the flat triangular oral plates characteristic of the *Urasterellids*. The nature of the spine-bearing ossicles is also of interest. Schuchert (1915, p. 174) describes long grooved spines springing from the adambulacrals, but Spencer (1914, pl. viii., fig. 7) show spines attached to the inframarginals in *U. medusa*. In *S. selwyni*, the long spines are undoubtedly attached to the inframarginals. McCoy compared *S. selwyni* with *U. ruthveni* (Forbes) from the Upper Ludlow beds of the Lake district; but this form is a true *Urasterella*, and is distinctly larger. A more closely related species now known is *S. (?) coronella* (Salter) (Spencer, 1918, p. 153, pl. xi., fig. 6; text-fig. 99).

The ossicles of the apical side are somewhat similar; but the form has less pointed arms and is smaller than *S. selwyni*. *S. (?) coronella* is from the Lower Silurian (May Hill Sandstones) of Worcestershire.

Associates.—*Salteraster biradialis*, sp. nov. Also *Dalmanites meridianus*; corals, brachiopods, &c.

Horizon.—Silurian.

Locality.—Range on E. side of Commonage, Kilmore. G.S.V. Loc. Bb23.

SALTERASTER BIRADIALIS, sp. nov.

(Pl. XI, Fig. 5; Text-figs. 9, 10.)

Five relatively slender convex arms radiating from a small central disc. For almost the entire visible length the sides of the arms are parallel, but the distal ends are in no case preserved. Apical sides of arms with two columns of subquadrate to rectangular radials, each with a granulate surface and a boss-like eminence. Entire margins of the rays made of row of inframarginal plates. In apical view these are round, with a convex surface, but laterally they can be seen to be elongate. Outside of them, in a few cases, there are some small plates, which must be displaced adambulacrals. Interbrachial angles with a small round interbrachial marginal visible also from oral side. Grooves wide, ambulacrals rectangular and ridged. Adambulacrals (15-20) prominent, swollen, and transverse rectangular. Inframarginals not visible, except close to interradius where they appear as a few small round plates. Oral plates small and triangular.

Dimensions.—Holotype: $R = \text{about } 12 \text{ mm.}$; $r = 1.5 \text{ mm.}$
Paratype: $R = \text{about } 7 \text{ mm.}$ (but distal end of arm not visible); $r = 1 \text{ mm.}$

Remarks.—*S. biradialis* is distinguished from *S. selwyni* by the shape of the arms, and the distinctive arrangement of the two central radial columns. The most nearly related foreign form is *S. (?) coronella* (Salter) (Spencer, 1914, p. 153, pl. xi., fig. 6; text-fig. 99) from the Lower Silurian (May Hill Sandstone) of Great Britain. This form, has, however, a single central radial column. It is also smaller. Most of the arms have the distal third broken off, but one which is better preserved is curved into an open S. This indicates a wriggling method of progression.

Associates.—As for *S. selwyni*.

Locality.—Range, E. side of Commonage Reserve, Kilmore. Geol. Surv. Vict. Loc. Bb23.

Horizon.—Silurian, from the same open reddish sandstone bed as *S. selwyni*.

Family SCHUCHERTIIDAE Schuchert.

Genus **Schuchertia** Gregory.

SCHUCHERTIA JUNORI, sp. nov.

(Pl. X., Fig. 3.)

Description:—Central disc of moderate size, with five long and pointed rays. Apical side unknown. Orally, grooves narrow; ambulacra strongly carinated; podial openings on sutures between plates, and close to adambulacra. Exact number of ambulacra difficult to determine, but in length of 10 mm. near centre of one of arms there are about 11. Adambulacra well developed, with convex granular surface, proximally subquadrate, medially more rectangular and distally broadly lunate. Each ambulacral is angulate nearest the ambulacral groove, the angle pointing to the carina of the adjoining ambulacral. Decreasing in size distally—most rapidly towards the slender tip of the ray. Inframarginal plates prominent, particularly in the proximal region where they are larger than adambulacra, subquadrate to transversely rectangular, with convex, granular surface. Distally, they rapidly decrease in size, till medially they are elongate, rectangular, and much smaller than the adambulacra. In places, particularly distally, the inframarginals appear to bear elongate spines, but from the sporadic occurrence of these they are probably paxillae displaced from the apical surface. Mouth angle plates adambulacral, large, high, and somewhat narrow. Interbrachial areas characterized by a rather prominent interbrachial marginal to either side of which are large inframarginals, while adorally are the prominent mouth angle plates and externally a mass of interbrachial accessory plates. These are mostly irregularly shaped and margin the arms for over one-half their length.

Madreporite fairly large, situated orally, in one of the interbrachial angles and close to the bordering inframarginals of one arm, finely and radially striate.

Dimensions of Holotype.— $R = 3.5$ cm., $r = 9$ mm.; diameter of madreporite, 2.0 mm.

Remarks.—This fine specimen is named after its finder, Mr. P. Junor, of Kinglake West, who was good enough to present it to the National Museum, Melbourne.

Generically it has some of the characters of both *Petraster* and *Palasterina*; it is excluded from the first by the absence of accessory plates from the area between the interbrachial marginal plate and the mouth; from the second by the prominent inframarginals which margin the oral side of the arms. The most closely related species is *S. lavata* Schuchert, from the Upper Ordovician of Great Britain and America (Schuchert, p. 198, pl. 32, fig. 3, pl. 33, figs. 2, 3; Spencer, 1920, pl. v., p. 212, pl. xv., fig. 1, text-figs. 150–153), but it is stouter, and its arms are shorter and disc broader than *S. junori*. Nevertheless,

the narrow ambulacral furrows, strongly carinate ambulacrals, shape of ambulacral plates and structure of interbrachial arcs suggest a close relationship. Another form which resembles ours is *S. wenlocki* Spencer (Spencer, 1920, p. 215, pl. xiv., figs. 5, 6, pl. xv., figs. 2-4, text-figs. 124, 127, 143, 145, 154-156) from the Wenlock of Britain. *S. wenlocki* has, however, a much larger madreporite and a wide ambulacral groove.

Associates.—*Pleurodictyum megastomum* Dun, *Furcaster leptosomoides* (Chapman), *Sturtzura brisingoides* (Gregory), *Chonetes bipartita* Chapman, *Rhynchotrema liopleura* McCoy, *Rutroclypeus junori* Withers.

Horizon.—Silurian. The above facies is distinctly Upper Silurian.

Locality.—Collins Quarry, Kinglake West, in hard greenish sandstone.

SCHUCHERTIA MACRARTA, sp. nov.

(Pl. XII, Fig. 3; Text-fig. 8.)

Description.—Pentagonal disc with five relatively slender rays arising somewhat abruptly, tapering slightly to the distal third, then rapidly to the terminal plate, which is imperfectly preserved. Ambulacral grooves relatively wide. Ambulacrals broad, about 20 in number, rectangular, opposite, with L-shaped ridges, the foot of the L directed along the median groove towards the disc. Adambulacrals smaller than ambulacrals, asymmetrically lunate-triangular, concave towards mouth, the inner end of the lune being in the same line as the carina of the adjacent ambulacral, swollen and finely granulate. The transverse axis of each adambulacral is not at right angles to the median axis of the arm, but has its outer end directed away from the disc. Inframarginals elongate and rectangular and smaller than the ambulacrals, extend for about one-half the length of the arm, but have not been found on all the arms. The oral structure has been lost from the central disc; instead, is seen the inner side of the covering plates which are polygonal and numerous. It is not possible to define the boundary between the inframarginals and the numerous interbrachial accessory plates, nor is the outer margin of the latter clearly defined, though probably concave. Few of the interbrachial accessory plates extend along the arms, and then only for a short distance. The arms are in consequence relatively slender and appear to leave the disc abruptly.

Dimensions of Holotype.—R:r:40 mm.:15 mm. These measurements are not exact as the outer margin of the disc and terminal plates of the rays are not clearly shown.

Remarks.—The holotype, which was found by Mr. R. Evans, is not well preserved, the interbrachial and oral structure being ill-defined. The inframarginal plates may be seen bounding the arm for about two-thirds their length, which character excludes the genus *Palasterina*. On the other hand, the inframarginals

are not sufficiently conspicuous for *Petraster*, nor are the arms stout enough. The closest form is *Schuchertia wenlocki* Spencer, from the Wenlock of Great Britain (Spencer, 1920, p. 215, pl. xiv., figs. 5, 6; pl. xv., figs. 2-4, text-figs. 124, 127, 143, 145, 154-156). The distinctive shape of the adambulacrals is the same in both forms (*vide* Spencer, *loc. cit.*, figs. 124, 155). The arms are, however, rather more petaloid than in *S. wenlocki*, and the inframarginals are not so well developed. In these respects our form shows some relationship with *Palasterina primaeva* (Forbes) (Spencer, *loc. cit.*, p. 225, fig. 161). The ratio R:r is about the same in *S. macrarta* and *S. wenlocki*, but the former is about twice as large. Indeed, *S. macrarta* is as large as the largest specimen of the American Upper Ordovician species, *S. laxata* Schuchert (Schuchert, 1915, pp. 198-9, pl. 32, fig. 3; pl. 33, figs. 2, 3; Spencer, *loc. cit.*, p. 212, pl. xv., fig. 1, text-figs. 150-153). In other respects, *S. laxata* is not closely related. The specific name refers to the slender arms (Latin, *macer*, lean; *artus*, limb).

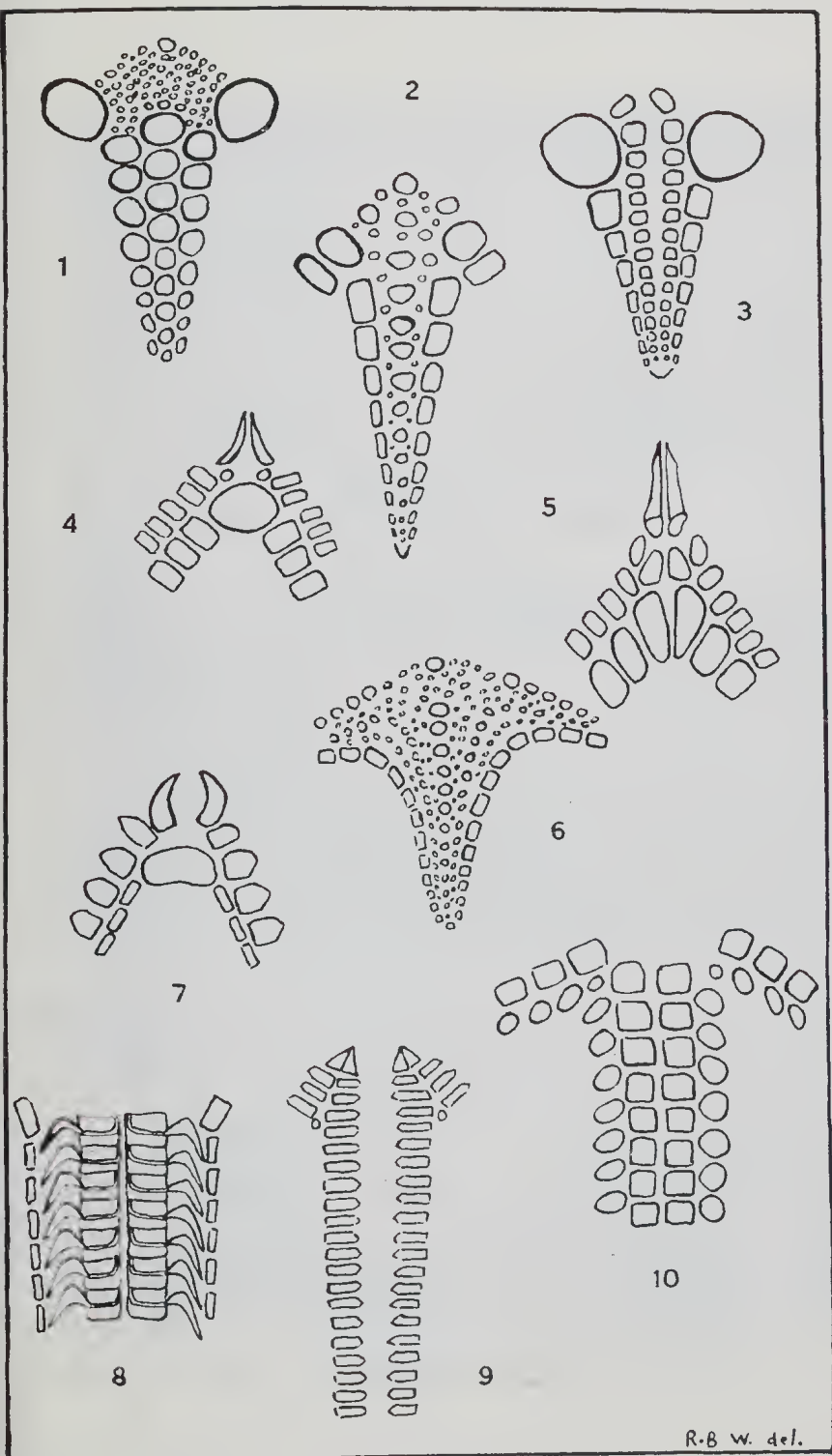
Associates.—*Bythotrepis gracilis* (J. Hall). *Discophyllum mirabile* Chapman (also found by Mr. R. Evans), *Camartocchia* sp., *Nucleospira australis* McCoy, *Euomphalus* sp., *Conularia* sp., ? *Endoceras* sp., ? *Ooceras* sp., *Calymene* sp., *Encrinurus* sp.

Horizon.—Silurian.

Locality.—Hoffman Brick Pit, Brunswick, in bluish mudstone, 100 feet below the surface.

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- 1925 (issued for 1922), Pt. VI., pp. 237-324, text-figs. 172-212, pl. xviii-xxii.



R-B w. del.

TEXT-FIGS. 1-10.
Palaeozoic Starfish.

TEXT-FIGS. 1-10.

- Fig. 1.—*Hudsonaster australis* sp. nov. Apical side $\times 7$.
 Fig. 2.—*Caractacaster yarraensis* sp. nov. Apical side $\times 7$.
 Fig. 3.—*Hudsonaster australis* sp. nov. Oral side $\times 7$.
 Fig. 4.—*Caractacaster yarraensis* sp. nov. Oral view of interbrachial structure. $\times 7$.
 Fig. 5.—*Promopalacaster meridionalis* (Eth. fil.) Oral view of interbrachial structure. $\times 6$.
 Fig. 6.—*Petraster angustior* sp. nov. Apical side $\times 2$.
 Fig. 7.—*Palasterina flemingtonensis* sp. nov. Oral view of interbrachial structure $\times 10$.
 Fig. 8.—*Schuchertia macrarta* sp. nov. Arrangement of ossicles on oral side in proximal region of arm $\times 4$.
 Fig. 9.—*Salteraster biradialis* sp. nov. Oral view of portion of arm $\times 8$.
 Fig. 10.—*Salteraster biradialis* sp. nov. Apical view of portion of arm and interradius $\times 10$.

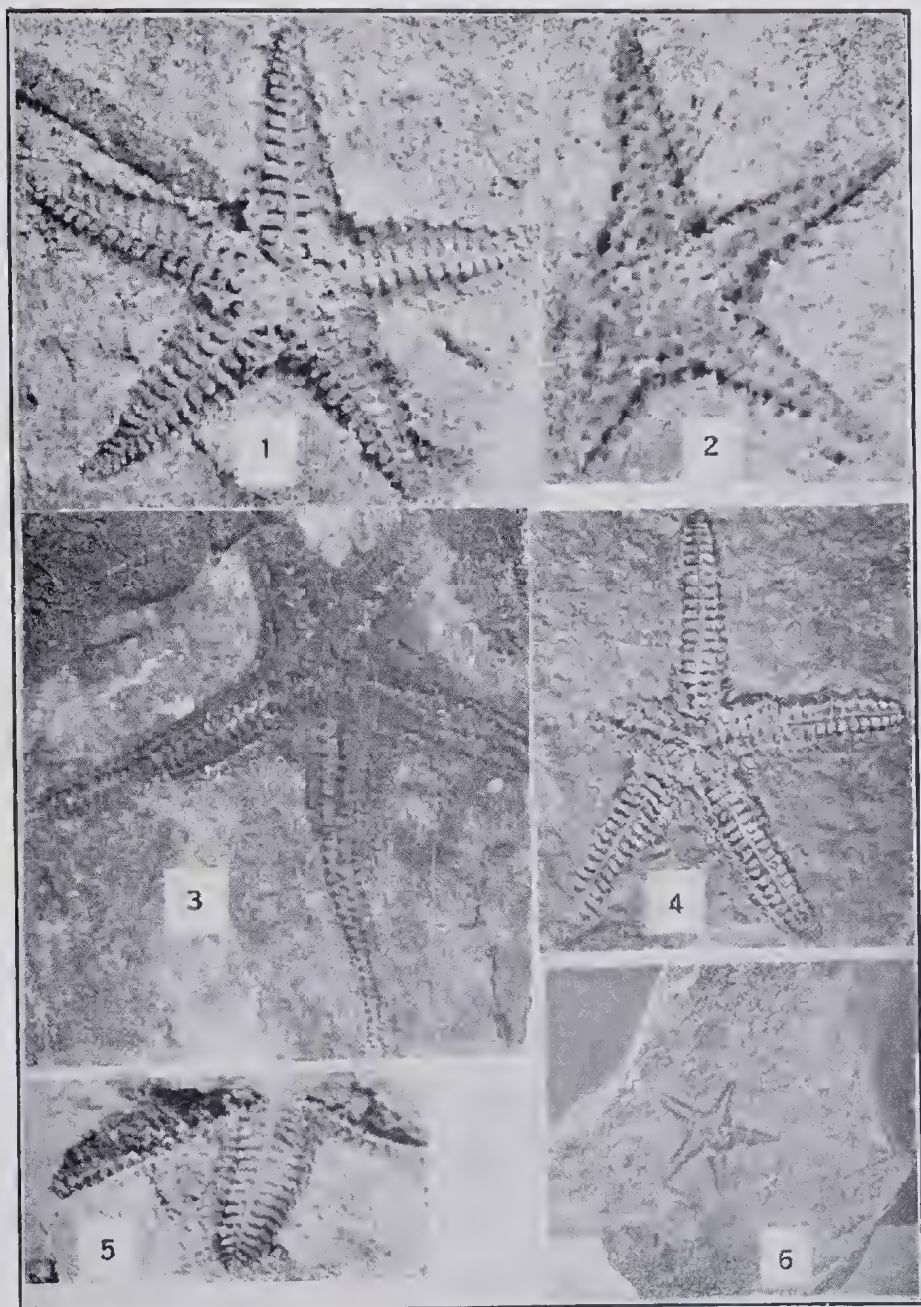
Explanation of Plates X.-XII.

PLATE X.

- Fig. 1.—*Caractacaster yarraensis*, sp. nov. Oral surface of syntype. $\times 4$. South Yarra. Coll. by F. P. Spry. Nat. Mus. Coll., No. 377.
 Fig. 2.—*C. yarraensis*, sp. nov. Apical surface of syntype. $\times 4$. South Yarra. Coll. by F. P. Spry. Nat. Mus. Coll., No. 377.
 Fig. 3.—*Schuchertia junori*, sp. nov. Oral surface of holotype. $\times 1.5$. Collins Quarry, Kinglake West. Coll. and pres. by P. Junor. Nat. Mus. Coll., No. 13808.
 Fig. 4.—*Palasterina umbonata*, sp. nov. Oral surface of holotype. $\times 1.5$. Near Plenty Ranges, 6 feet beneath surface. Purchased by Nat. Mus. from Miss M. E. Macfarlane. No. 13810.
 Fig. 5.—*Promopalacaster meridionalis* (Eth. fil.) var. *parvior*, nov. Oral surface of holotype. $\times 3$. Moonee Ponds Creek, Flemington. Coll. by Geol. Surv., Vict. Nat. Mus. Coll., No. 13816.
 Fig. 6.—*Hudsonaster australis*, sp. nov. Oral surface of syntype. $\times 1.5$. At the summit of an anticline in a cutting on Yan Yean-Arthur's Creek-road, $\frac{3}{4}$ mile east of Doreen Junction. Nat. Mus. Coll., No. 13806.

PLATE XI.

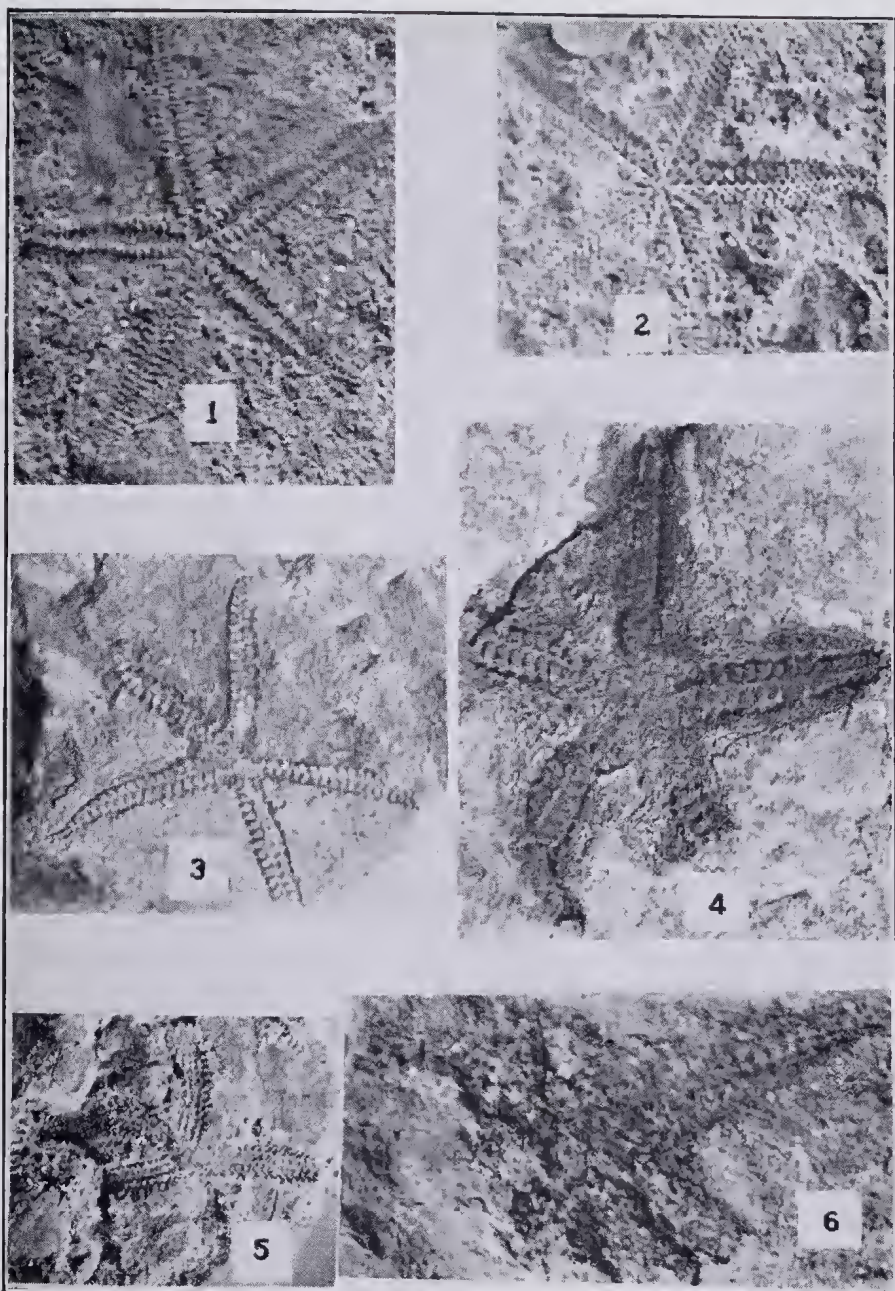
- Fig. 1.—*Salteraster selwyni* (McCoy). Oral side of syntype. $\times 2.5$. Range on east side of Commonage, Kilmore. Geol. Surv. Loc. Bb 23. Nat. Mus. Coll., No. 12207.
 Fig. 2.—*Salteraster selwyni* (McCoy). Apical side of syntype. $\times 2.5$. Same locality. Nat. Mus. Coll. No. 12208.
 Fig. 3.—*Palasterina flemingtonensis*, sp. nov. Oral side of holotype. $\times 1.5$. "Flemington," near Melbourne. Nat. Mus. Coll., No. 13813.
 Fig. 4.—*Palasterina stachi*, sp. nov. Oral side of holotype. $\times 2$. Excavation for foundation of Herald Office, corner of Collins-place and Flinders-street, Melbourne. Pres. by L. Stach. Nat. Mus. Coll., No. 13811.
 Fig. 5.—*Salteraster biradialis*, sp. nov. Photograph of holotype showing arrangement of adradials on apical side. $\times 2.3$. Range east of Commonage Reserve, Kilmore. Geol. Surv. Loc. Bb. 23. Nat. Mus. Coll., No. 352.
 Fig. 6.—*Palasterina stachi*, sp. nov. Apical side of paratype. $\times 2$. Same locality as holotype. Nat. Mus. Coll., No. 13812.



R.A.K. photo.]

Palaeozoic Starfish.

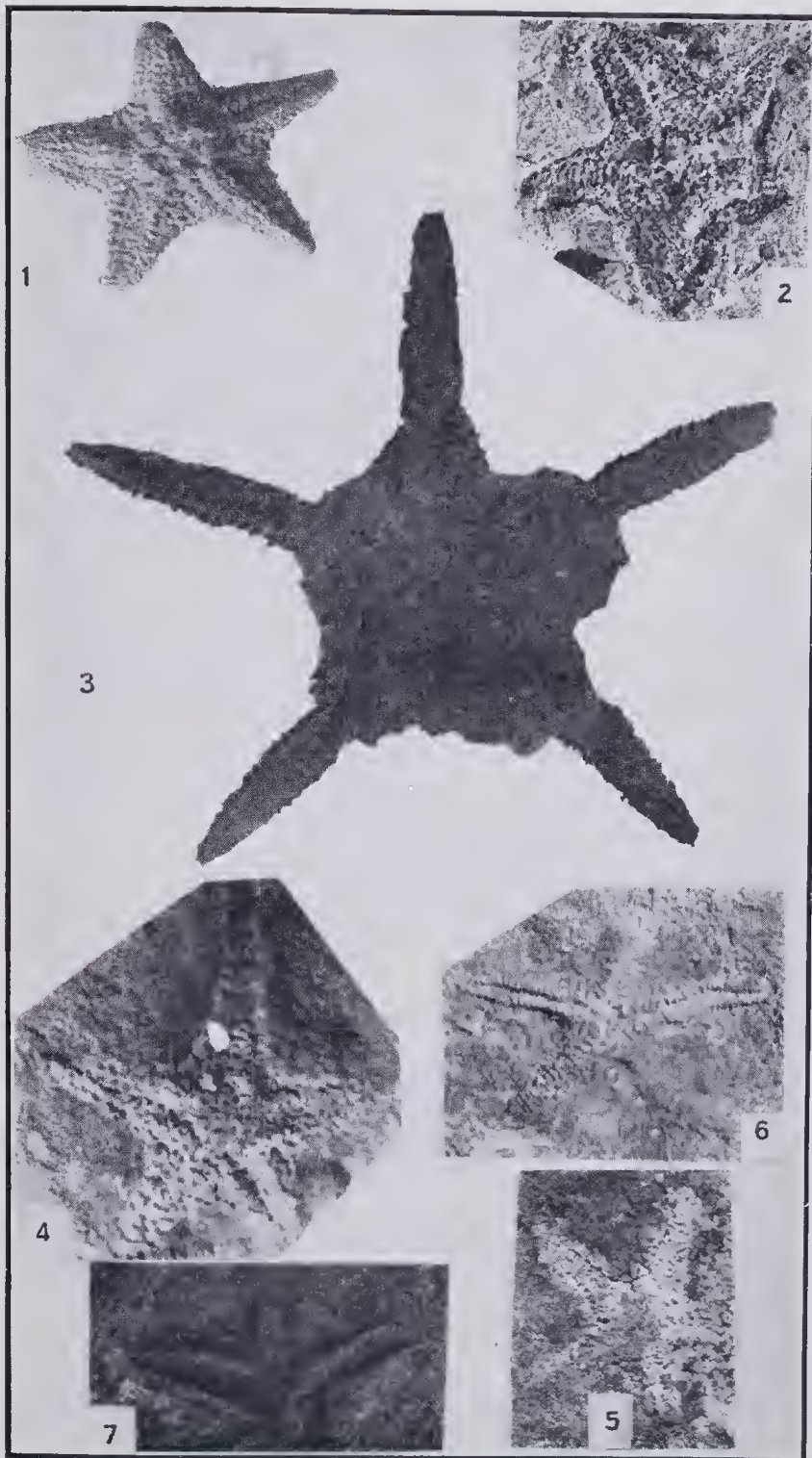
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R.A.K. photo.]

Palaeozoic Starfish.

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R.A.K. photo.]

Palaeozoic Starfish.

PLATE XII.

- Fig. 1.—*Petraster smythi* (McCoy). Apical side. $\times 1.5$. Wax impression of plesiotype. From near East Kilmore. Sweet Coll., Nat. Mus. Coll., No. 13815.
- Fig. 2.—*P. smythi* (McCoy). Apical side of holotype. $\times 1.5$. Moonee Ponds Creek, Flemington. Nat. Mus. Coll., No. 7604.
- Fig. 3.—*Schuchertia macrarta*, sp. nov. Oral surface imperfectly preserved. $\times 1.5$. Hoffman Brick Pit, Brunswick. Nat. Mus. Coll., No. 13809.
- Fig. 4.—*Petraster angustior*, sp. nov. Apical surface of holotype. $\times 1.5$. South Yarra. Nat. Mus. Coll., No. 374.
- Fig. 5.—*Petraster angustior*, sp. nov. Paratype, showing apical view of ambulacrals. $\times 1.5$. South Yarra. Nat. Mus. Coll., No. 372.
- Fig. 6.—*Urasterella cresswelli*, sp. nov. Oral side of holotype. $\times 1.4$. Mudstone Quarries, Lilydale. Coll. and pres. by Rev. A. W. Cresswell to Nat. Mus. Coll., No. 13817.
- Fig. 7.—*Promopalaeaster meridionalis* (Eth. fil.). Photograph of Etheridge's type in possession of Australian Museum, Sydney. $\times 1.4$.